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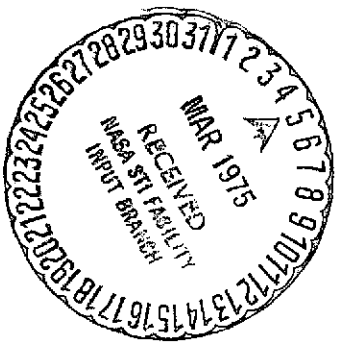
# STRUCTURE AND CONDITIONS OF THE LUNAR INTERIOR

I.N. Galkin



Translation of "Stroyeniye i sostoyaniye nedr Luny," Priroda, No. 10, October 1974, p. 105

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16. Abstract

Lunar crust, upper, middle and lower mantle, and "core" are characterized by thickness and composition, based on seismograms of H. Latham's group (University of Texas) at Soviet-American lunar and planetary cosmochemistry conference in Moscow.

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# STRUCTURE AND CONDITIONS OF THE LUNAR INTERIOR

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At a Moscow conference [1], the leader of the materials processing group of the lunar seismic experiment, H. Latham (University of Texas, United States), reported new data on the interior structure of the Moon. /105*

Crust. In the area of the Ocean of Storms a thick (60 km) two-layer crust has been discovered, overlain with basalts (velocity 5 km/sec) and underlain with gabbro-anorthosites (7 km/sec). Evidently the crust is a global feature of the Moon, but its properties vary; in particular, in highland areas it can be one-layer, of gabbro-anorthosite composition, while on the far side it must be much thicker. The boundary of the crust and the mantle is reliably diagnosed from seismic observations.

The upper mantle extends to 300-350 km; the velocity of waves in it drop from 8.1 to 7.8 km/sec due to a rise in temperature. It may be that immediately beneath the crust-mantle boundary there is a high-velocity layer [2] up to 40 km thick. The most probable composition of the upper mantle is olivine-pyroxene; the primordial gabbro-anorthositic crust of the Moon may have been melted from this layer.

The middle mantle (about 300-800 km down) is characterized by a sudden drop in the velocity of transverse waves from 4.7 to 4.0 km/sec. This means that the elastic modulus of matter -- Poisson's ratio -- rises markedly. For dense crystalline rocks it is usually 0.25, but here it jumps to 0.35, which, for example,

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* Numbers in the margin indicate pagination in the foreign text.

is characteristic of terrestrial clays. This strange feature is supposedly accounted for by the fact that the middle mantle is the primordial material of the Moon that had never been remelted -- the result of the accumulation of meteoritic particles and bodies. The boundary of the upper and middle mantle evidently is quite sharp: in several seismograms supplementary phases of exchange waves corresponding to it have been detected between the incursions of longitudinal and transverse waves. The entire outer belt of the Moon 800 km thick is called the "lithosphere" on analogy with Earth.

Lower mantle. Beneath the focal zone of moonquakes transverse waves are strongly absorbed or not transmitted. This is shown by tracings of moonquakes and the impact of a meteorite on the far side of the Moon. The velocity of longitudinal waves in this zone decreases somewhat, but by not more than 0.3 km/sec. According to the model of the Moon's thermal history proposed by N. Toksoz and co-workers, the zone of partial melt (called the "asthenosphere" on analogy with Earth), for the first billion years of the Moon's history occupying its external region, gradually descended into the interior. Today below 800 km the temperature is up to 1500°C.

"Core" of the Moon. Thus far only one seismogram was obtained from the fall of a distant meteorite, where waves "peering" deeper than 1300 km were delayed 60 sec. If this is so, the velocity of longitudinal waves in the center must be very low -- 5 km/sec, and it is not precluded that the interior core of the Moon, of small dimensions, is formed of iron sulfide. Its mass is 1% of the Moon's mass and does not markedly affect the moment of inertia, but its existence could account for the recently noted magnetization of rocks at the lunar surface caused by the action of a magnetic dynamo in the lunar center during an early stage of the Moon's evolution.

The proposed model of the structure and condition of the lunar interior will be revised and modified as new data accumulate.

REFERENCES

1. Sovetsko-amerikanskaya konferentsiya po kosmokhimii Luny i planet [Soviet-American Conference on the Cosmochemistry of the Moon and Planets], Moscow, "Nauka" Press, 1974.

2. Priroda (8), 104 (1974).